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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).
Attorney Docket Number: 1002.01US01

INVENTORS/APPLICANTS

Given Name (first and middle)	Family Name or Surname	Residence (City and either State or Foreign Country)
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[ ] Additional inventors are being named on the _____ separately numbered sheets attached hereto.

TITLE OF THE INVENTION (500 characters max)

NANOFILTRATION WATER TREATMENT SYSTEM FOR WATER SOFTENERS

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ENCLOSED APPLICATION PARTS

[X] Specification Number of pages __6___
[X] Drawings Number of sheets __2___
[ ] Application Data Sheet. See 37 CFR 1.76
[ ] CD-ROM or CD-R in duplicate and Compact Disc Transmittal
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NANOFILTRATION WATER TREATMENT SYSTEM FOR WATER SOFTENERS

FIELD OF THE INVENTION

The present invention relates to water softening systems. In particular, the present invention relates to a water softening system having a filtration system that separates hardness ions from brine so that the brine can be recycled instead of being discharged with the hardness ions.

BACKGROUND OF THE INVENTION

Among industrialized nations of the world, there is a growing concern for and emphasis on environmentally responsible practices. For example, more and more governments and communities are interested in minimizing the kinds and quantities of chemicals that are deposited into water systems, including wastewater systems. A common form of wastewater pollution is the brine solution discharged into sewers or septic systems during typical regeneration processes of water softeners.

For the last fifty years or so, water softening has become widely used in those regions where water supplies contain high concentrations of calcium and magnesium and are therefore considered "hard". Utilizing a sodium ion exchange process, resin-based water softeners are installed on water lines, particularly those leading into residences, to soften most if not all of the water used inside these homes. As a water supply passes through the ion exchange resins inside a water softener, the calcium and magnesium are removed from the water supply.

Periodically, these ion exchange resins must be regenerated. Typically, this regeneration is accomplished utilizing a brine solution such as sodium chloride. In a typical regeneration process, the brine solution is slowly pumped through the resin bed. Through a chemical exchange process, the calcium and magnesium ions which were adsorbed onto the resin are stripped off and replaced with sodium ions. At the conclusion of this process, the "spent" brine solution containing both the hardness ions and the brine is discharged into the sewer or septic system. This discharge has serious long term

effects on the environment, as the brine salinity, total dissolved solids, and/or chloride concentrations are depleting the planet's fresh water supplies.

Presently, because this pollution problem has defied resolution by economically acceptable means, some communities are resorting to banning water softening in homes. For example, in December 2002, a "Salinity Summit Meeting", held to review the water standards for the Colorado river and to discuss plans for salinity control, was attended by over 125 participants from 13 states and the District of Columbia. In 1999, because many of its municipalities were in danger of violating waste discharge permits or water reclamation permits, the State of California reversed its policy prohibiting cities from banning water softeners. Scientific studies such as that conducted by Santa Clarita, California are finding that brine solution discharge from water softeners is a significant source of water pollution and thus support prohibitions of, or restrictions on, present, commercially available water softening systems. Consequently, removing the salts from the spent brine solution before the solution is discharged has become an immediate and real concern of communities that want soft water and of water softener manufacturers.

SUMMARY OF THE INVENTION

The present invention describes an apparatus and a process to separate hardness ions from spent brine solution to allow most of the brine solution to be recycled back into a water softener, thereby reducing the discharge of brine into the environment.

Nanofiltration is a pressure driven, membrane separation technology that separates ionic solute from water supplies based on the ionic strength of the solute. Preferred embodiments of the present invention include a pump that supplies the force required to effect the separation and feeding a spent brine solution or feed stream into a housing containing a nanofilter membrane element. Preferably, the nanofilter ("NF") membrane element has a spiral-wound configuration, although other configurations are possible, such as capillary fiber, tubular, or plate and frame. The following are examples, without limitation, of NF membranes that are acceptable for use in the present invention, although their manufacturers may or may not have their products evaluated for this application: a spiral wound NF-270 membrane, made by Dow Filmtec; a spiral-wound

XN45 membrane, by TriSep Corp.; a spiral-wound SR2 membrane, by Koch Membrane Systems; a spiral-wound NF membrane using a special polymer, by Hydranautics; a spiral-wound membrane using a special polymer, by Sepro; a spiral-wound NF membrane using a special polymer, by GE Osmonics; and a capillary fiber NF50 membrane, by Norit X-Flow.

In a nanofiltration process, multivalent salts are rejected to a higher degree than monovalent salts. Thus, nanofiltration used as part of a water softener system can be used to selectively remove hardness ions from a spent brine solution and direct them to a drain while monovalent salts that make up the brine solution are recycled to a water softener brine tank. With the present invention, approximately 90% or more of the brine solution that typically is discharged into a drain can be recovered and recycled, thereby minimizing water pollution as well as the cost of water softener salt from which brine solution is prepared.

Preferred embodiments of a nanofiltration water treatment system consist of at least one nanofiltration membrane element, at least one pump in fluid communication with at least one brine tank and the at least one NF membrane element, a first outlet in fluid communication with the at least one NF member element and a second outlet in fluid communication with the at least one NF member element and the brine tank. Typical fluid communication is made via pipeline or direct adjoinment, and alternative means of creating pressure can be implemented with or instead of a pump. Brine solution is fed from the brine tank to the NF membrane element so that as much of the feed stream as possible passes through the membrane. From each NF membrane element, a permeate stream, that portion of the feed stream that is forced through the NF membrane element, containing a reduced quantity or no hardness ions, is returned to the brine tank; and the concentrate stream, that portion of the feed stream that cannot be forced through the membrane, containing most if not all the hardness ions and possibly a small amount of brine, is directed to a drain or septic tank. To create back pressure, in the case of a pressurized feed, necessary to generate the permeate stream, a valve or orifice is inserted into the means of communication of the concentrate stream. Preferred embodiments may or may not include pressure gauges and flow meters to monitor performance.

The overall operation of the system can be described as follows: When the softener goes into regeneration, during the brine/slow rinse cycle, the valve, modified accordingly, directs the effluent from this cycle back into the brine tank. During the fast rinse cycle, the effluent may or may not be directed to the brine tank, depending on the salinity of this stream. While the softener is in service, the NF system will operate over at least an 8 hour period to slowly process the contents of the brine tank, removing and discharging hardness ions and recycling brine solution.

To incorporate the NF system into a softener, the following modifications will be required: The softener valve must direct the effluent from the brine/slow rinse cycle back to the brine tank. The softener valve may direct some or all of the effluent from the fast rinse cycle back to the brine tank. This decision will be based on a predetermined degree of salinity of this solution. To accommodate this additional brine solution, the brine tank can be increased from the typical capacity of approximately 30 gallons to approximately 60 gallons. The water softener valve is adjusted so that during the "brining" and "slow rinse" cycles, the effluent (discharge stream) is directed back to the brine tank, rather than to the drain.

Although the preferred embodiments of the nanofiltration water treatment system for water softeners have been described herein, it should be recognized that numerous changes and variations can be made to these embodiments, which changes and variations are still within the scope and spirit of the present invention. The present invention should not be unduly limited by the illustrative embodiments and examples set forth herein for exemplary purposes. Rather, the scope of the present invention is to be defined by the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a diagram of a water softener system including a nanofiltration water treatment system.

Figure 2 is a diagram of a nanofiltration water treatment system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention can be understood with reference to the Background, Summary, and figures attached hereto.

THAT WHICH IS CLAIMED:

1. The invention as shown and described above.
2. The methods for implementing the invention, as shown and described above.
3. The methods for making the invention, as shown and described above.

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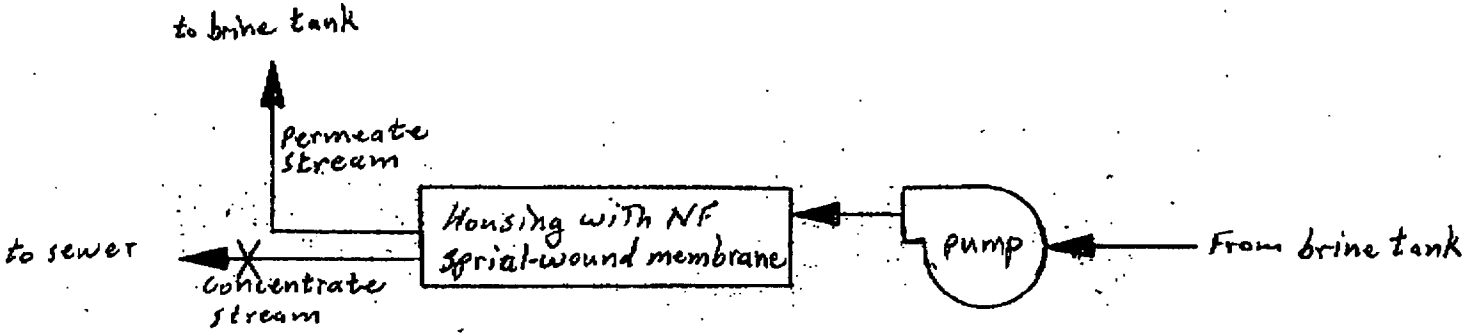

NF SYSTEM

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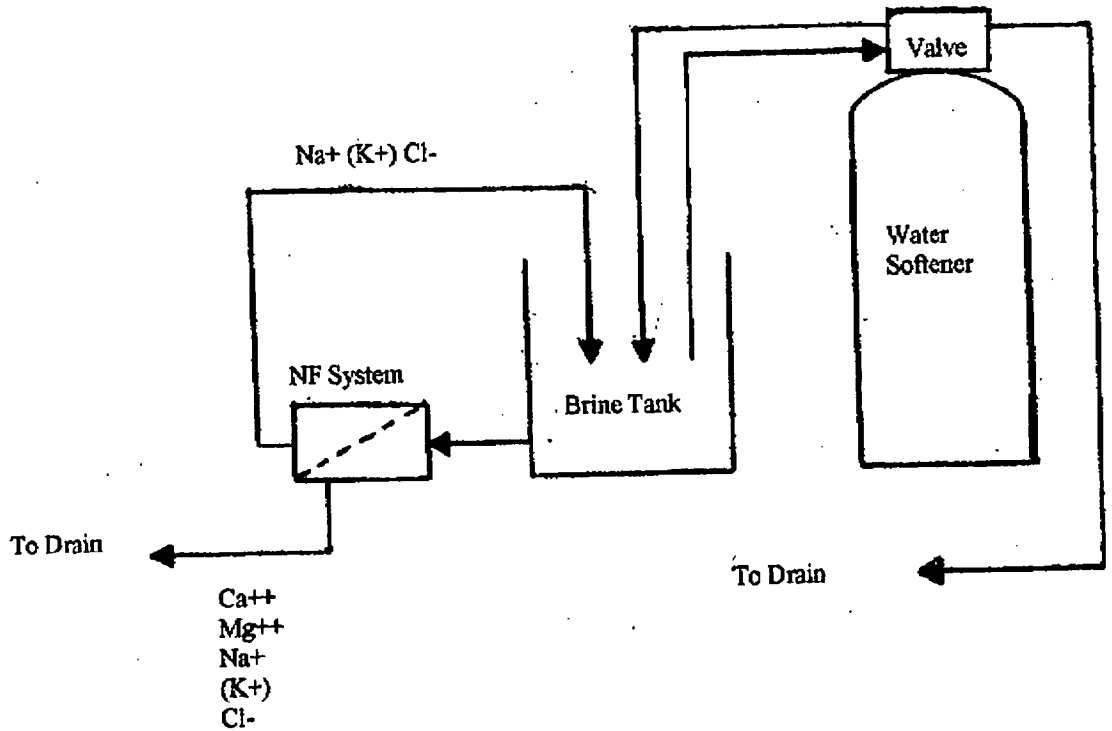
FIGURE 1



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